C - Anatomy and Physiology C Exam - Pearl City Invitational - 12-12-2020

Test Breakdown

- Use this table to help determine what sections to do
- Please note that the mixed short answer sections are worth the majority of the points.
- Feel free to skip questions if needed

	Multiple Choice	Mixed Short answer + Application	Pathology
[85] Part I: Integumentary System	15	43.5	26.5
[85] Part II: Skeletal System	15	48	22
[85] Part III: Muscular System	15	43	27

Part I: Integumentary System

[15] Multiple Choice

1. (1.00 pts) Which of the following skin color changes are caused by benign tumors of blood vessel endothelial cells?

- (●) A) birth mark
- ( ) B) ephelides
- ( ) C) lentigos
- ( ) D) liver spots
- ( ) E) mole

2. (1.00 pts) The pericardium surrounding the heart is an example of what kind of membrane?

- ( ) A) mucous
- (●) B) serous
- ( ) C) cutaneous
- ( ) D) synovial

3. (1.50 pts) The picture below shows a condition that could lead to squamous cell carcinoma as a complication. What is depicted?

- A) 1st degree burn
- B) 2nd degree burn
- C) athelete's foot
- D) bedsore
- E) carbuncles
- F) human papilloma virus

4. (1.50 pts) All the following are true about melanocytes except:

- A) melanosomes contain the melanin produced by melanocytes
- B) melanin breaks down in lysosomes
- C) pseudopods of melanocytes distribute melanin to cells
- D) melanin protects a cell's DNA from damage by UV radiation

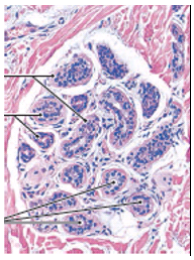
5. (1.50 pts) A baby with a known cardiovascular disorder is born with a bluish tint to the skin. What condition does this baby have? What pigment causes this condition?

- A) anemia, hemoglobin
- B) anemia, red blood cells
- C) cyanosis, bilirubin
- D) cyanosis, hemoglobin
- E) jaundice, bilirubin
- F) jaundice, hemoglobin

6. (1.50 pts)
An adult woman was involved in a burn injury. After examination, it was found that she burned her posterior lower back, the back of both her arms, and her posterior left leg. What percent of the body was burned?

- A) 9
- B) 13.5
- C) 18
- D) 22.5
- E) 27
- F) 36

7. (1.50 pts) The histology of a skin gland is shown below. It includes myoepithelial cells which secrete fluid into a lumen. What skin gland is shown?



- A) apocrine

- (●) B) eccrine
- ( ) C) lacrimal
- ( ) D) sebaceous

8. (1.50 pts) Which of the following statements describe vellus hairs? Choose all that apply.

(Mark **ALL** correct answers)

- [ ] A) appear after 3 months of fetal development
- [x] B) can convert to terminal hairs when stimulated by hormones
- [ ] C) examples include eyebrows and eyelashes
- [x] D) is present on a normal adult human

9. (2.00 pts) Thin and thick skin are two skin types that vary in their characteristics. Choose all of the choices below that do not pertain to thin skin.

(Mark **ALL** correct answers)

- [x] A) located on the soles of feet
- [ ] B) thickness 1-2 millimeters
- [ ] C) has stratum spinosum
- [x] D) numerous sudoriferous glands
- [x] E) has epidermal ridges
- [ ] F) has sebaceous glands

10. (2.00 pts) Which of the following about ceruminous glands are true? Choose all that apply.

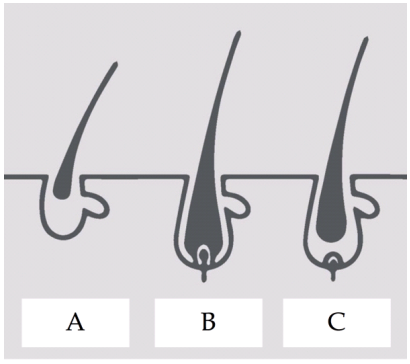
(Mark **ALL** correct answers)

- [ ] A) cerumen can activate an immune response against bacteria in the ear canal
- [x] B) ceruminous glands are a type of apocrine gland
- [ ] C) ceruminous glands are specialized sebaceous glands
- [x] D) ceruminous glands secrete a substance called cerumen
- [x] E) the secretions of these glands combine with other secretions to form earwax

[50] Mixed Short Answer

[5] Answer the following questions about hair!

Examine the picture of the stages of hair growth below.



11. (1.00 pts) What is the name of stage C? (One word answer)

Catagen

12. (1.50 pts) Alopecia is the condition where hair falls out in patches due to an immune response. Which part of the hair is likely targeted by the immune system in alopecia?

- A) cortex
- B) external root sheath
- C) hair matrix
- D) hair papilla
- E) hair root

13. (1.50 pts) A man with alopecia decides to undergo a hair revival treatment. What stage of hair growth would be sought in his hair revival treatment?

- A) Stage A
- B) Stage B
- C) Stage C

[6.5] Research has shown that adipose-derived stem cells (ADSCs) can promote hair growth and stimulate angiogenesis, which is the formation of new blood vessels.

14. (1.50 pts) Which part of the hair is likely targeted by ADSCs?

- A) cortex
- B) external root sheath
- C) hair matrix
- D) hair papilla
- E) hair root

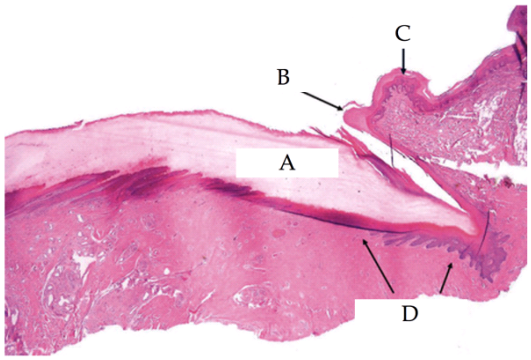
15. (4.00 pts) How would adipose-derived stem cells affect the process of wound healing? Mention a specific stage of wound healing in your response.

Expected Answer: It will affect the proliferative stage (+1) of wound healing. Because ADSCs stimulate the creation of more blood vessels, it will accelerate this phase and cause immune cells to be carried to the injury site quicker (+1.5). This makes it easier to clean up the wound site and for wound healing to proceed (+1.5).

16. (1.00 pts)
Alopecia is related to another skin disorder, where the skin loses pigmentation instead of hair in patches. Both disorders are related to the immune system. What skin disorder is this? (One word answer)

Vitiligo

[5] The histology of a mystery structure is shown below. Different structures are labeled A-D,



17. (1.50 pts) What is the function of D?

Expected Answer: Produce new keratinocytes for growth of nail

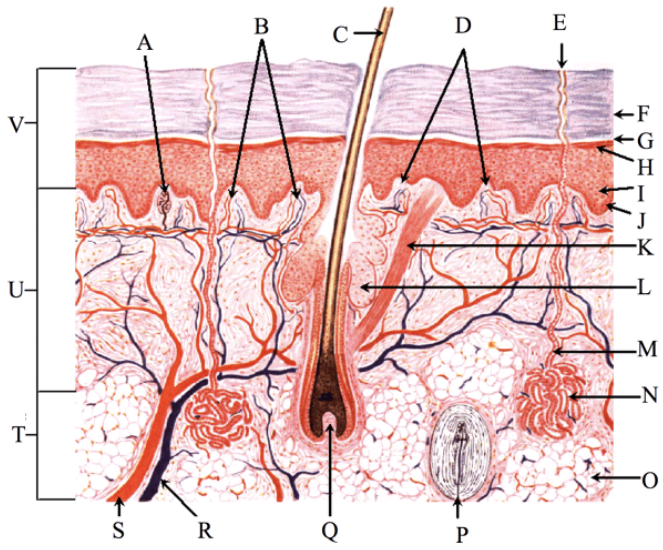
18. (2.00 pts) What is C referring to? What is B referring to?

Expected Answer: Proximal nail fold (+1), Cuticle (eponychium) (+1)

19. (1.50 pts) What is ONE way psoriasis affects this structure?

Expected Answer: Psoriasis may cause pitting of the nail bed and separation of the nail body from the nail bed (+1.5 for ANY).

[10.5] A cross sectional view of skin is shown below.



20. (1.00 pts) The epidermis shown in the diagram has five distinct layers. What type of skin is this?

- (●) A) Thick
- ( ) B) Thin

21. (1.00 pts) Name one inaccuracy this diagram has regarding the type of skin shown.

Expected Answer: Presence of hair follicle, of arrector pili, or sebaceous gland in thick skin (+1 for ANY; various responses accepted)

22. (1.00 pts) Name the letter (A-V) of the layer of skin that contains eleidin. (One letter answer)

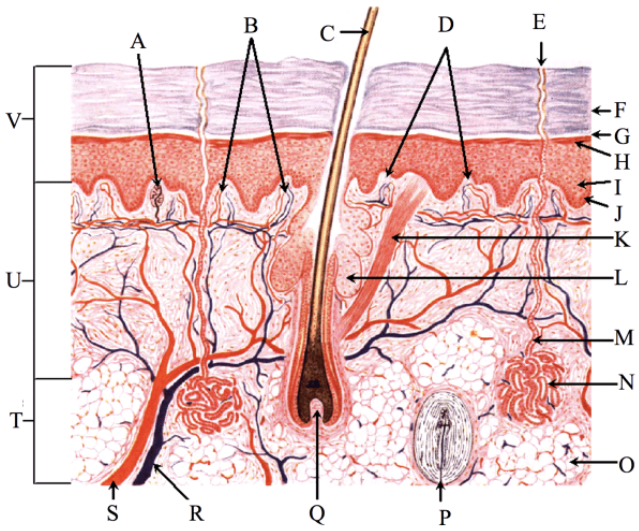
G

23. (1.00 pts) What are the letters (A-V) of the layers of skin that are made up of dead, nondividing cells? Choose all that apply.

(Mark **ALL** correct answers)

- [x] A) F
- [x] B) G
- [ ] C) H
- [ ] D) I
- [ ] E) J
- [ ] F) U

24. (1.50 pts) Label T is made up of what kind of tissue? Choose all that apply.



(Mark **ALL** correct answers)

- [x] A) Adipose
- [x] B) Areolar
- [ ] C) Dense irregular
- [ ] D) Mesenchymal
- [ ] E) Stratified squamous

25. (3.00 pts) What are labels K and L? How does K aide in the function of L?

Expected Answer: K is an arrector pili (+1) and L is a sebaceous gland (+1). An arrector pili contracts to move the secretions of the sebaceous gland into the hair follicle (+1).

26. (1.00 pts) What does receptor P sense?

Expected Answer: Deep pressure and vibration change

27. (1.00 pts) What is skin receptor A?

Expected Answer: Meissner's corpuscle

[17.5] The buildup of reactive oxygen species (ROS) are thought to play a role in skin aging. ROS increases collagen breakdown and disrupt proteoglycans in the extracellular matrix, a structure surrounding cells made of many proteins and other molecules. A few examples of ROS are shown in the table below.

			
Superoxide ion	Hydroxyl ion	Peroxide	Hydrogen Peroxide

28. (1.50 pts) Smoking has been shown to increase the amount of ROS in the skin. How might this affect aging of the skin? Choose all that apply.

(Mark **ALL** correct answers)

- [ ] A) Smoking will decrease the rate of aging in the skin
- [x] B) Smoking will increase the rate of aging in the skin
- [ ] C) Smoking will lead to less signs of aging at an older age
- [x] D) Smoking will lead to more signs of aging at a younger age

29. (1.00 pts) Based on the description given, which layer below does ROS affect the most?

- (●) A) Dermis
- ( ) B) Epidermis
- ( ) C) Hypodermis

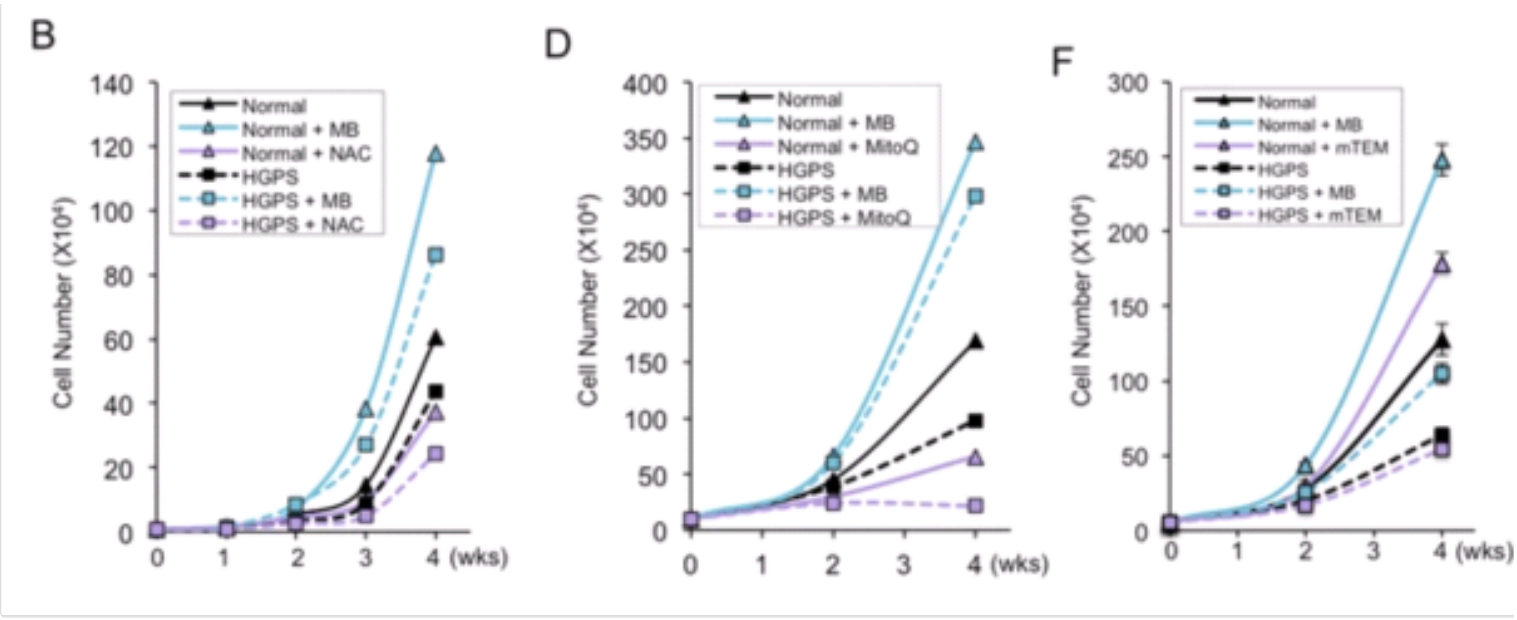
30. (2.00 pts) How does the effects of ROS account for the decrease in skin thickness as one ages? Mention how ROS level changes as age increases.

Expected Answer: ROS causes a breakdown in collagen (and the ECM), a main structural component in skin (+1). ROS increases when a person ages, so more collagen will be broken down leading to thinner skin (+1).

In a study, scientists tested the effects of a potential compound called methylene blue in reducing the effects of reactive oxygen species.

Scientists measured fibroblast cell number across a 4-week time period in skin treated with 4 antioxidants: methylene blue (MB), N-acetyl-L-cysteine (NAC), MitoQ, and mTEM. Two different skin samples were treated with antioxidants; normal skin and skin affected by a disease called Hutchinson-Gilford progeria syndrome (HGPS).

- **Graph B** displays the cell number for normal and HGPS skin treated with MB and NAC.
- **Graph D** displays the cell number for normal and HGPS skin treated with MB and MitoQ.
- **Graph F** displays the cell number for normal and HGPS skin treated with MB and mTEM.



31. (1.00 pts) Based on the data, how did methylene blue change the fibroblast cell population as time progressed?

- A) decrease
- B) increase
- C) stay the same

32. (1.00 pts) How many more fibroblasts did normal skin treated with MB have than normal skin without treatment in graph B?

- A) 10
- B) 20
- C) 30
- D) 40
- E) 50

33. (1.50 pts) Which antioxidant below caused the greatest increase in fibroblast cell number in normal skin?

- A) NAC
- B) MitoQ
- C) mTEM

34. (4.00 pts) Would methylene blue be beneficial the process of wound healing? Explain why. In your response, mention the function of a fibroblast during wound healing.

Expected Answer: Yes (+1). It is shown that MB leads to incerased number of fibroblasts (+1). In wound healing, fibroblasts secrete new collagen in the repairing wound site (+1). With more fibroblasts due to MB, wound sites heal faster (+1).

35. (2.00 pts) Based on the scenario and data given, which of the following best describes the effect of HGPS on the skin?

- A) HGPS acts against N-acetyl-L-cysteine, which could increase the number of ROS in the skin
- B) HGPS causes the skin to age at a much faster rate than normal skin, which could decrease the action of antioxidants
- C) HGPS acts against antioxidants, preventing them from reducing the effects of ROS
- D) HGPS destroys fibroblasts in respone to added antioxidants, causing cell numbers to decrease as antioxidants increase

36. (1.50 pts) There are two ways to lower the levels of ROS:

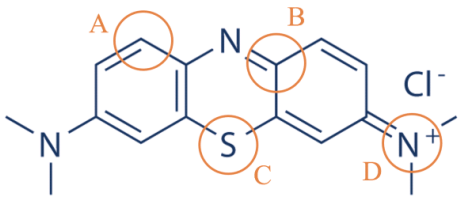
1. neutralizing existing ROS

2. decreasing the production of ROS

Which way of lowering ROS is being investigated in this experiment?

- A) Way 1
- B) Way 2

37. (2.00 pts) Examine the structure of methylene blue below. There are 4 atoms that are labeled A-D.



Methylene blue

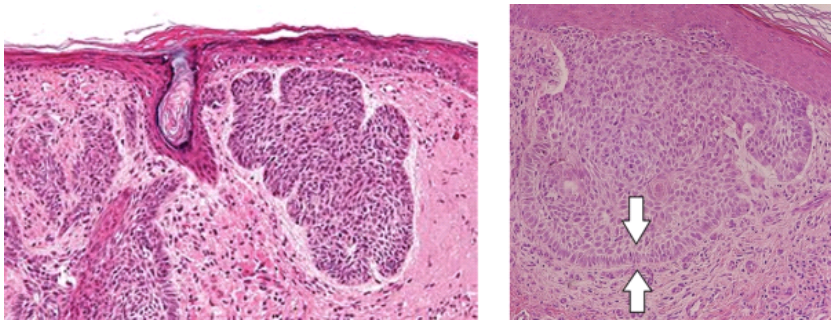
Which atom most likely contributes to methylene blue's ability to decrease the effects of reactive oxygen species (act as an antioxidant)?

- A) Atom A
- B) Atom B
- C) Atom C
- D) Atom D

[15.5] Pathology: Identification

Note: Disease, disorder, and injuries are used synonymously in this section

The following questions pertain to the two figures below:



38. (1.50 pts) What disease is shown in the pictures above? (Fill it out as stated on the 2021 rules)

Basal cell carcinoma

39. (1.00 pts) What is the most common cause of this disease?

Expected Answer: Overexposure to sunlight (UV)

40. (1.00 pts) In what layer of the skin does this disease occur?

- (●) A) basale
- ( ) B) corneum
- ( ) C) dermis
- ( ) D) granulosum
- ( ) E) lucidum
- ( ) F) spinosum

41. (2.00 pts)
The picture to the right highlights a common feature of this disease, shown by the two white arrows as a ridge of cells. What is this feature called? (One word answer)

Expected Answer: Palisading

42. (1.50 pts) A 25-year-old patient with a dark red to black nodule wanted to know if he had this disease. Would you diagnose him with it?

- ( ) A) Yes
- (●) B) No

The following questions pertain to the figure below:

43. (1.50 pts) What disease is shown in the patient above? (Answer as stated in the 2021 rules)

Scabies

44. (1.00 pts) If the patient in the picture was undergoing chemotherapy and is immunocompromised, what form of this disease could occur?

Expected Answer: Crusted (Norwegian) scabies

45. (2.00 pts) Why does the skin become red and inflamed? (*Hint*: think about the immune system)

Expected Answer: There is an inflammatory response (+1) to proteins and feces from the mite (+1)

46. (1.50 pts) Which of the following would be an effective treatment for this disease?

(Mark **ALL** correct answers)

- [ ] A) benzyl peroxide
- [ ] B) humectants
- [ ] C) mupirocin
- [ ] D) pencillin
- [x] E) permethrin
- [x] F) stromectol

47. (1.50 pts) The attending physician asks for the patient to apply the treatment all over the skin. What would happen if the patient did not follow this direction?

Expected Answer: Spots that were not covered would provide a place that mites could survive and continue to cause symptoms

[12.5] Pathology: Case Study

Note: Disease, disorder, and injuries are used synonymously in this section

Gary is a 70-year-old male who enjoys swimming at his local YMCA. While swimming there, he often uses the public locker rooms and showers while being barefoot. He has recently been undergoing chemotherapy treatment for cancer. He smokes regularly but has a healthy weight. He enjoys going on nature walks and works in construction. Gary complains of having several white lesions on his tongue. Gary also complains of warts on his foot that are painful when he walks around.

48. (1.50 pts) With respect to his complaints about his mouth, what disease does he have? Be specific.

Expected Answer: Oral thrush OR Oral candidiasis

49. (1.00 pts) What is ONE pathogen that most commonly cause this disease? Give the scientific name.

Expected Answer: Candida albicans, Candida tropicalis, Candida glabrata (+1 for ANY)

50. (1.50 pts) Is it normal for this pathogen to be present on an adult without symptoms?

- (●) A) yes
- ( ) B) no

51. (2.00 pts) Name TWO reasons why Gary might be more at risk for having this disease.

Expected Answer: He smokes (+1) and is undergoing immunosuppressive therapy (+1)

52. (1.50 pts) What disease is causing his painful warts? (Answer as stated in the 2021 rules)

Expected Answer: Human Papillomavirus (HPV)

53. (1.00 pts) What specific type of wart does Gary have?

Expected Answer: plantar warts

54. (1.00 pts) The type of cancer Gary has is closely related to the infection of the above pathogen. Given this, what type of cancer is Gary being treated for?

Expected Answer: cervical cancer

55. (2.50 pts)
Gary is also concerned about some thickened skin on his hand. He uses a hammer often when working in construction and he uses his hands often. Identify what these might be. Should he be worried about this? If he desires to get rid of this, what can he do?

Expected Answer: Callus (+1). No, he should not be concerned (+0.5). Treat with salicylic acid, sand down, etc. (+1)

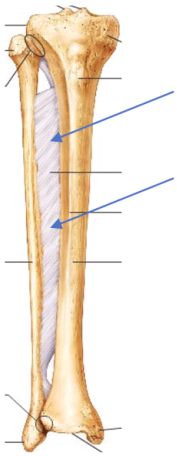
Part II: Skeletal System

[15] Multiple Choice

56. (1.00 pts) Which of the following synovial joint types has the least range of motion?

- A) saddle
- B) plane
- C) condylar
- D) hinge
- E) more than one joint type listed

The two questions that follow pertain to the figure below.



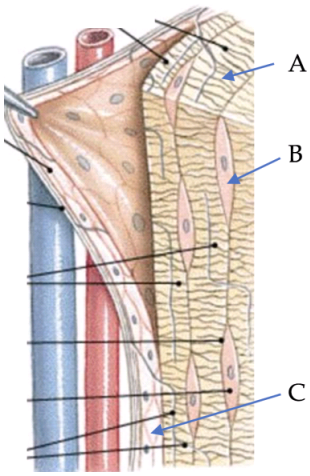
57. (1.00 pts) The joint shown by the blue arrows is an example of a …

- A) synchondrosis
- B) syndesmosis
- C) symphysis
- D) synostosis

58. (1.00 pts) Where in the body are these bones located?

- A) arm
- B) leg
- C) pectoral girdle
- D) spinal column

The two questions that follow pertain to the figure below.



59. (1.00 pts) What tissue layer is shown with arrow C and what subdivision of that layer is shown?

- A) endosteum, fibrous layer
- B) endosteum, osteogenic layer
- C) periosteum, fibrous layer
- D) periosteum, osteogenic layer

60. (1.00 pts) Compact bone is arranged into layers called lamellae. What type of lamellae is A?

- A) circumferential
- B) concentric
- C) compact
- D) interstitial
- E) linear

61. (1.00 pts)
Whiplash can occur when a person's head is suddenly moved back and forth. It is a common complication of injuries in sports and car accidents. What vertebra type is damaged ir whiplash?

- A) cervical
- B) lumbar
- C) sacral
- D) thoracic

62. (1.50 pts) Osteoblasts, osteocytes, and osteogenic cells arise from …

- A) granulocyte progenitor cells
- B) mesenchymal stem cells
- C) hematopoietic stem cells
- D) glial cells

The two questions that follow pertain to the figure below.

63. (1.50 pts) What type of Salter Harris facture is shown in the imaging to the right?

- A) Type I
- B) Type II
- C) Type III
- D) Type IV
- E) Type V

64. (1.00 pts) What bone is the orange arrow referring to?

- A) capitate
- B) hamate
- C) lunate
- D) pisiform
- E) schaphoid
- F) trapezoid

The two questions that follow pertain to the figure below.

65. (1.50 pts) What condition does this person have?

- A) achondroplasia
- B) ankylosing spondylitis
- C) scoliosis
- D) spinal stenosis
- E) spinal fracture

66. (2.00 pts) What is the approximate measure of the Cobbs angle in the patient?

- A) 0

- B) 15
- C) 45
- D) 75
- E) 90
- F) 135

67. (1.50 pts) A 55-year-old woman has been diagnosed with osteoporosis. Choose ALL of the following that could be useful in treating osteoporosis.

(Mark **ALL** correct answers)

- [x] A) hormone therapy
- [ ] B) R.I.C.E
- [ ] C) hydrocortisone
- [x] D) teriparatide

[46] Mixed Short Answer

[11.5] Answer the following questions about bone growth

68. (1.50 pts)
The metaphysis has many zones, all of which play a role in the conversion of cartilage to bone and ultimately bone growth. In what zone does mitosis of chondrocytes stop and lacunae walls thin?

- A) cell hypertrophy
- B) bone deposition
- C) calcification
- D) reserve cartilage

69. (1.50 pts) The zones mentioned in the previous question pertain to what type of growth?

- A) appositional
- B) endochondral
- C) interstitial
- D) proximal

70. (1.00 pts) Which bone cell acts first during endochondral ossification?

- A) osteoblasts
- B) osteoclasts
- C) osteocytes

Examine the x-ray below.

71. (1.00 pts) Where in the body was this picture taken?

- (●) A) elbow
- ( ) B) foot
- ( ) C) hip
- ( ) D) knee
- ( ) E) shoulder
- ( ) F) spine

72. (1.50 pts) What bone marking is shown with the blue arrow? (Two word singular answer).

Trochlear notch

73. (1.00 pts) What type of synovial joint is shown?

- ( ) A) ball and socket
- ( ) B) condylar
- (●) C) hinge
- ( ) D) pivot
- ( ) E) plane
- ( ) F) saddle

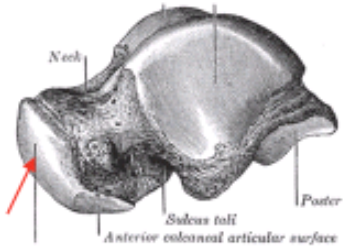
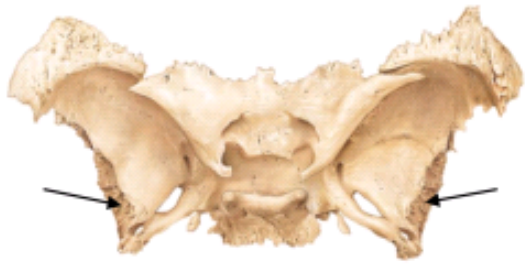
74. (1.00 pts) Is this joint monoaxial, biaxial, or multiaxial?

- (●) A) monoaxial
- ( ) B) biaxial
- ( ) C) multiaxial

75. (3.00 pts) Was this x-ray taken in an adult or child? How can you tell?

Expected Answer: Adult (+1). The epiphyseal plates have closed, as seen by the absence of a clear line between the diaphysis and epiphysis of the leg bones / bone size is larger in an adult / joint space is smaller (+2 for ANY).

[9.5] Identify which bone in the human body is shown in each question below and answer some accompanying questions. Each bone identification answer should only be one word!

Bone A (____ view)	Bone B	Bone C (inferior view)
		

76. (1.50 pts) Identify bone A. (One word answer)

Talus

77. (1.00 pts) From which direction is bone A being viewed?

- A) anterior
- B) lateral
- C) posterior

78. (1.00 pts) What bone forms a joint with bone A at the red arrow? (One word answer)

Navicular

79. (1.50 pts) Identify bone B. (One word answer)

hyoid

80. (1.50 pts) What ligament attaches to bone B at the blue arrow? (One word answer)

Stylohyoid

81. (1.50 pts) Identify bone C. (One word answer)

Sphenoid

82. (1.50 pts) What bone borders this bone at the black arrows? (One word answer)

Temporal

[6] In the 1950's, lead paint was commonly used to paint house walls and children toys. Unfortunately, this resulted in high levels of lead poisoning in the future.

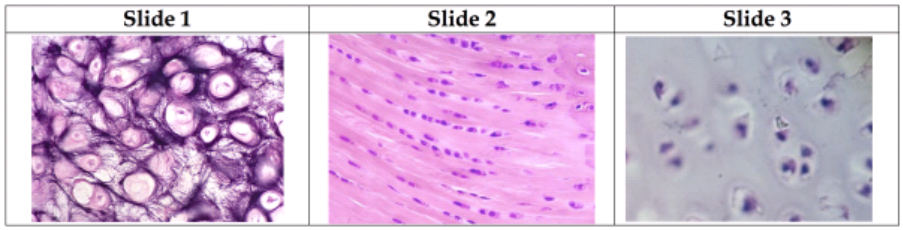
83. (3.00 pts) Why and how does the skeleton incorporate lead into the bones? What bone cell is involved?

Expected Answer: Osteoblasts (+1) incorporate heavy metals similar to calcium ions into the skeleton while forming the bone matrix, which includes lead / form stable complexes inside of bone (+2).

84. (3.00 pts) If lead is incorporated into the bones, how come lead poisoning was still occurring in people even after exposure to lead was stopped?

Expected Answer: Bone remodeling still occurs (+2). Bone tissue is constantly being resorbed and reformed by bone cells (+1).

[7] Answer the following about cartilage in the skeleton. Three slides are shown below that show different types of cartilage.



85. (1.00 pts) What type of cartilage is shown in Slide 1? (One word answer)

fibrocartilage

86. (1.00 pts) What type of cartilage is shown in Slide 3? (One word answer)

Hyaline

87. (2.00 pts)
The cuneiform cartilages of the larynx are made up of what type of cartilage? Can this type of cartilage return to its original shape, and what characteristic of this type of cartilage explains this?

Expected Answer: Elastic (+1). Yes, it contains lots of elastic fibers (+1).

88. (3.00 pts) Janice has a crushed intervertebral disc. What type of cartilage is affected? Why is this injury so difficult to heal? How does antiangiogenesis factor affect healing?

Expected Answer: Fibrocartilage (+1). Cartilage is nonvascularized, decreasing the rate of healing (+1). Antiangiogenesis factor prevents the formation of blood vessels (+1), keeping cartilage nonvascularized.

[14] Dual-energy x-ray absorptiometry (**DEXA**) is a way of evaluating the bone mass density (BMD) of an individual. Bone mass density measures the amount of mineral per volume in bones.

To measure the difference from the typical value of a patient's BMD, values called t-scores and z-scores can be used.

The z-score is calculated by the following formula:

$$z - score = \frac{Patient\ BMD\ -\ Expected\ BMD}{Standard\ Deviation}$$

The **expected BMD** and **standard deviation** (**SD**) for patients with a certain age and race are given in *Table 1*.

The conversion from z-score to t-score is:

$$t - score\ =\ z - score\ +\ Reference\ t - score$$

Reference t-scores for a certain age and race are given in *Table 2*.

If the value of the t-score for a patient falls below a certain value, it can indicate that they have a higher risk for osteoporosis or that they have osteopenia, as shown in *Graph 1*.

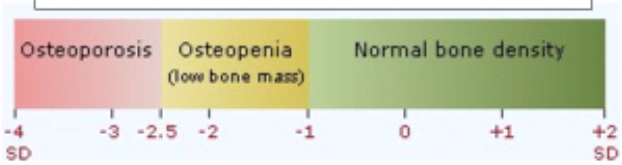
Table 1: Expected BMD and SD

	White Women		White men		Black Women		Black Men	
Age	BMD	SD	BMD	SD	BMD	SD	BMD	SD
25	955	123	1055	146	1040	135	1189	171
35	945	130	1038	144	1017	142	1141	166
45	920	136	1002	140	1034	160	1094	162
55	876	139	990	143	973	175	1072	185
65	809	140	969	157	890	154	1027	168
75	740	129	928	151	838	154	984	173
85	679	135	859	161	723	146	933	194

Table 2: Reference T-scores

Age	Men	Women	Men, black	Women, black
25	0.00	0.00	0.00	0.00
35	-0.12	-0.09	-0.28	-0.17
45	-0.37	-0.29	-0.56	-0.04
55	-0.44	-0.65	-0.69	-0.50
65	-0.60	-1.19	-0.95	-1.11
75	-0.87	-1.75	-1.21	-1.50
85	-1.35	-2.25	-1.50	-2.35

Graph 1



89. (1.00 pts) Briefly explain what osteopenia is.

Expected Answer: The loss of bone mass as a person ages

90. (2.00 pts) Based on the Table 1, how does the bone mass density of men and women compare? Explain why this might be so.

Expected Answer: Women BMD is lower than men (+1). This might be due to hormonal changes that causes a decrease in bone density (menopause) (+1)

91. (2.00 pts) Why does osteoporosis have a low t-score? In your response, mention how osteoporosis affects values in the z-score formula.

Expected Answer: Osteoporosis decreases the patient bone mass density (+1), which would lead to a less x-score and z-score overall (+1).

92. (3.50 pts) A 55-year-old black male has a BMD of 1150. Calculate the t-score to the nearest tenth. **Show your steps**, partial credit may be given!

Expected Answer: -0.3 (If correct, +2 for correct answer and 1.5 for any amount of work; If incorrect, +1.5 for attempt at solution)

93. (1.00 pts) What does he have?

- A) osteoporosis
- B) osteopenia
- C) normal bone density
- D) overly dense bones

94. (3.50 pts) A 75-year-old white woman has a BMD of 703. Calculate the t-score to the nearest tenth. **Show your steps**, partial credit may be given!

Expected Answer: -2.0 (If correct, +2 for correct answer and 1.5 for any amount of work; If incorrect, +1.5 for attempt at solution)

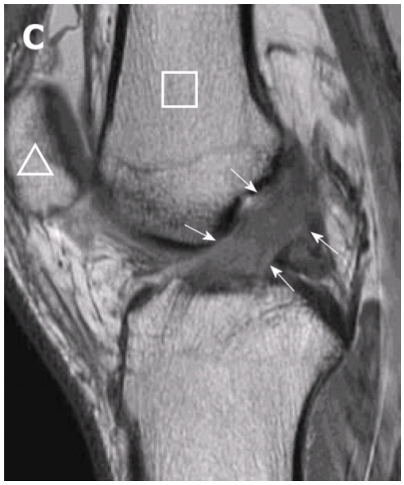
95. (1.00 pts) What does she have?

- A) osteoporosis
- B) osteopenia
- C) normal bone density
- D) overly dense bones

[10.5] Pathology: Identification

Note: Disease, disorder, and injuries are used synonymously in this section

[5.5] The questions below refer to the picture and scenario below:



A doctor orders an imaging test to be done after a patient comes complaining about a constant pain and weakness when walking.

96. (1.50 pts) What disease is shown in the picture? (Answer as stated on the 2021 rules)

Expected Answer: ACL tear

97. (1.00 pts) What bone is labeled by the white triangle? (One word singular answer)

patella

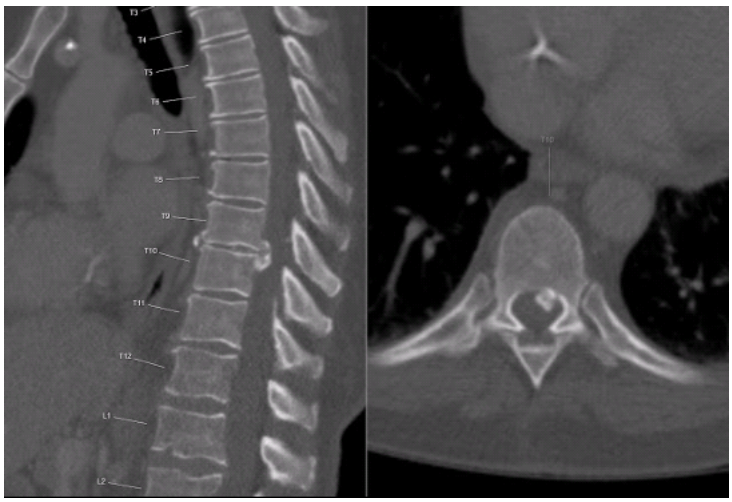
98. (1.50 pts) What type of fracture can occur if the force during injury is great enough? (One word answer)

Avulsion

99. (1.50 pts) Name ONE potential treatment option for this disease.

Expected Answer: Rest, ice, compression, elevation (R.I.C.E.), physical therapy, bracing, surgery (+1.5 for ANY)

[5] The questions below refer to the picture below:



100. (1.50 pts) What disease is shown in the picture above? (Answer as stated in the 2021 rules)

Disc herniation

101. (1.00 pts) What imaging technique was used?

- A) CT
- B) MRI
- C) X-ray

102. (1.00 pts) What other disease on the 2021 disease list might this lead to? (Answer as stated on the 2021 rules)

Spinal stenosis

103. (1.50 pts) What is ONE preventative method?

Expected Answer: Exercise, maintain healthy weight, posture, diet, don't smoke. (+1.5 for ANY)

[11.5] Pathology: Case Study

Note: Disease, disorder, and injuries are used synonymously in this section.

Mark comes to the doctor's office with complaints of hearing loss and pain in his arms and legs. He has a record of many fractures in his ribs and arms and has a bluish tint to his eyes (shown above). The attending physician Dr. Moyer takes these records and symptoms into consideration. He asks Mark if these types of symptoms have run in his family in which he replies yes.

104. (1.50 pts) What disease should Dr. Moyer diagnose Mark with? (Answer as stated on 2021 rules)

Osteogenesis imperfec

105. (1.00 pts) What group of bones are affected by this disease that causes Mark's hearing loss?

Expected Answer: ossicles

106. (2.00 pts) What protein's synthesis is affected by this disease? Be specific!

Expected Answer: Collagen (+1) I (+1)

107. (1.50 pts) Why does this disease cause a bluish tint shown in the picture?

Expected Answer: It disrupts collagen synthesis, which would cause less collagen to be present in the sclera of the eye (+1.5).

108. (3.00 pts)
Dr. Moyer asks Mark if he bruises more easily. Why might Dr. Moyer ask this? Explain using ONE effects of this disease on certain structures. What will Mark likely say?

Expected Answer: He may ask this because osteogenesis imperfecta causes thinning of the blood vessel lining due to decreased collagen / skin is thinned making it easier to break underlying blood vessels (+1). This would make it easier to break when impacted, bruising his skin more often (+1). Mark might say that he does bruise more easily (+1).

109. (2.50 pts)
Dr. Moyer suggests that Mark could take bisphosphonates to help treat one of his symptoms. Why might Dr. Moyer suggest this treatment? Explain, using the effects of bisphosphonates. Mention one specific symptom that is mitigated by this treatment.

Expected Answer: Bisphosphonates increase bone density (+1.5), which could decrease the brittleness of bones and help decrease the amount of bone fractures that occur (+1).

Part III: Muscular System

[15] Multiple Choice

110. (1.00 pts) Which of the following does not insert at the ischial tuberosity?

- A) biceps femoris
- B) gracilis
- C) semimembranosus
- D) semitendinosus

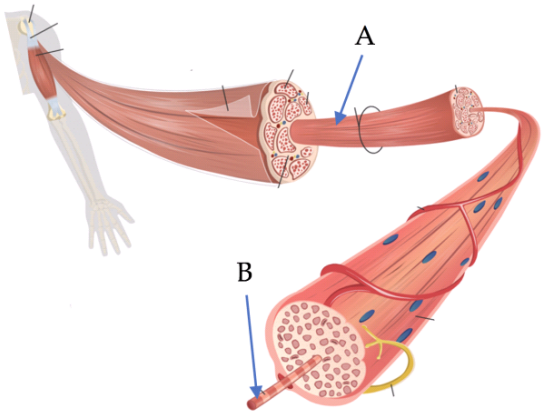
111. (1.00 pts) Which muscle is shown in the picture below?

- A) tibialis anterior
- B) fibularis brevis
- C) fibularis longus
- D) gastrocnemius

112. (1.00 pts) Where are synaptic vesicles found in the neuromuscular junction?

- A) bound on the motor end plate
- B) in the presynaptic neuron
- C) in the synaptic cleft
- D) in the sarcoplasm

The three questions that follow refer to the picture below.



113. (1.00 pts) The cross section of what muscle is shown in the picture?

- A) brachialis
- B) brachioradialis
- C) biceps brachii
- D) triceps brachii

114. (1.00 pts) What connective tissue surrounds the structure labeled A?

- A) endomysium
- B) epimmysium
- C) dense fascia
- D) perimysium
- E) superficial fascia

115. (1.00 pts) What structure does B refer to?

- A) fascicle
- B) microfilament
- C) muscle fiber
- D) myofibril

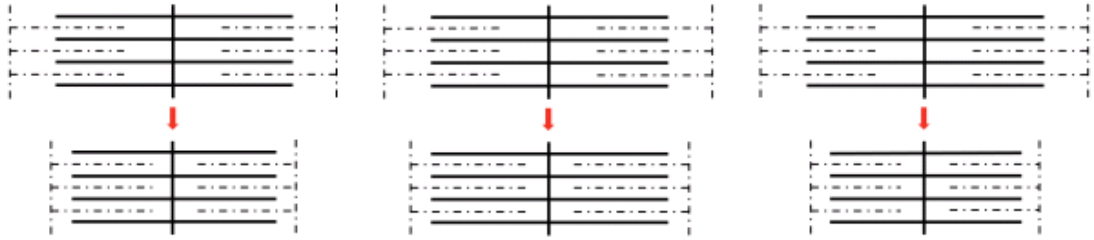
116. (1.50 pts) Polymerization of G-actin subunits forms what protein complex?

- A) nebulin
- B) actin filament
- C) F-actin
- D) troponin

117. (1.50 pts) Which of the following correctly describes the amount of ground substance and fibrous tissue in tendons?

- A) lots of fibrous tissue, low amounts of ground substance
- B) lots of fibrous tissue and ground substance
- C) low amounts of fibrous tissue, lots of ground substance
- D) low amounts of fibrous tissue and ground substance

118. (2.00 pts) Which model below correctly depicts what occurs during contraction in the sliding filament model? Choose all that apply, if any at all.



Model A Model B Model C

(Mark **ALL** correct answers)

- [ ] A) model A
- [x] B) model B
- [ ] C) model C

119. (2.00 pts) Which of the following statements are TRUE regarding myositis?

(Mark **ALL** correct answers)

- [ ] A) polymyositis involves muscles of the limbs
- [x] B) treatment can involve the use of anti-inflammatory agents
- [x] C) a cause can be related to autoimmune disease
- [x] D) symptoms of dermatomyositis include chronic inflammation and a skin rash

120. (2.00 pts) Select all the following which are true about the contraction phase of a single muscle twitch.

(Mark **ALL** correct answers)

- [ ] A) the A band increases in size
- [x] B) the H zone decreases in size
- [ ] C) incomplete tetanus occurs
- [x] D) myosin heads associate with actin
- [ ] E) tension slightly rises, stays at a constant level, and rises to a maximum level

☑ F) the troponin-tropomyosin complex moves off the active sites of actin

[43] Mixed Short Answer

[11.5] Answer the following about the different kinds of muscle tissue.

121. (1.00 pts) What type(s) of muscle tissue has the ability to release calcium from the sarcoplasmic reticulum?

(Mark **ALL** correct answers)

☑ A) cardiac

☑ B) skeletal

☐ C) smooth

Although each type of muscle tissue is unique, they have analogous structures. Identify the structure in every muscle type for each description.

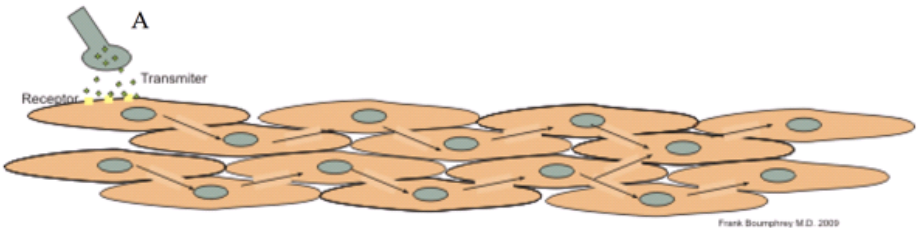
122. (3.00 pts) Structure that connects all the contractile units to produce tension. Mention the analogous structure in skeletal, cardiac, and smooth muscle.

Expected Answer: Skeletal- Z-discs, Cardiac- intercalated discs OR Z-discs, Smooth- dense bodies (+1 EACH)

123. (3.00 pts) Protein that calcium binds to that allows for contraction to occur. Mention the analogous structure in skeletal, cardiac, and smooth muscle.

Expected Answer: Skeletal- troponin, Cardiac- troponin, Smooth- cadmodulin (+1 EACH)

Below is a picture of a certain type of muscle tissue.



124. (1.00 pts) What type of muscle tissue is shown in the picture?

○ A) cardiac

B) skeletal

C) smooth

125. (1.00 pts) What type of neuron is pictured (label A)?

A) autonomic

B) somatic

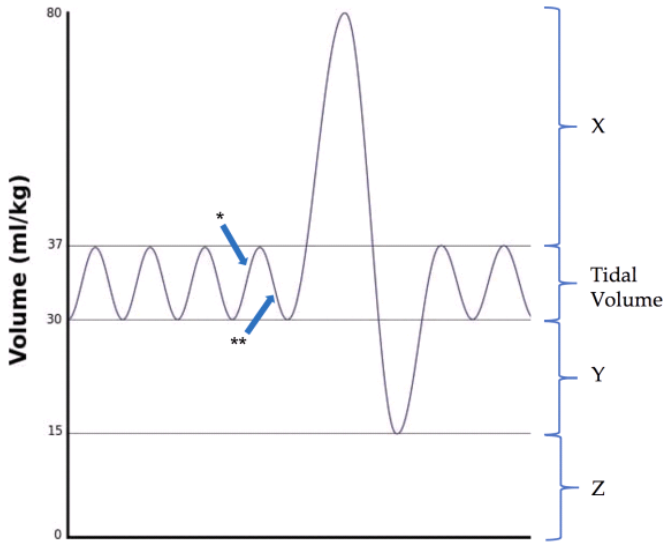
126. (1.00 pts) That type of cellular connections are seen between the myocytes above?

Expected Answer: Gap junction

127. (1.50 pts) Where in the body could this muscle tissue be found?

Expected Answer: It could be found along the digestive tract, in the bladder, and in the uterus (+1.5 for ANY)

[10] Below is a **spirograph**, which displays of the *volume of air within the lungs* during passive and active breathing over time.



128. (1.00 pts) How much more air can be inhaled during passive inhalation?

A) 7 ml/kg

- B) 15 ml/kg
- C) 43 ml/kg
- D) 50 ml/kg
- E) 65 ml/kg
- F) 80 ml/kg

129. (2.00 pts) What muscle(s) in the 2021 Major Skeletal Muscle list are mainly involved in the part of the graph labeled with a *, if any at all?

Expected Answer: The diaphragm and external intercostals (+1 EACH)

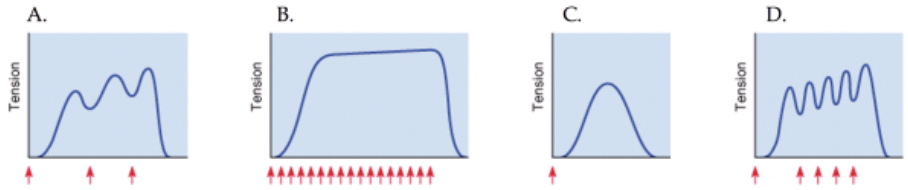
130. (2.00 pts) What muscle(s) in the 2021 Major Skeletal Muscle list are mainly involved in the part of the graph labeled with a **, if any at all?

Expected Answer: No muscles (+2)

131. (5.00 pts)
Myasthenia gravis can lead to life-threatening symptoms known as myasthenia crisis. Explain how myasthenia gravis affects the action of respiratory muscles from the cellular level (*Hint*: think about receptors). Why does this lead to a life-threatening situation?

Expected Answer: In myasthenia gravis, antibodies from the immune system attack nicotinic acetylcholine receptors on the sarcolemma (+1). This decreases the number of places for acetylcholine to bind during neural stimulation (+1), reducing the amount of action potentials sent and thus muscle contraction in affected skeletal muscles (+1). When this occurs in skeletal muscles involved in breathing, asphyxiation can occur (+2).

[11] Answer the following questions that refer to the myograms below.



132. (1.00 pts) What do the red arrows symbolize?

Expected Answer: Neural stimulation

133. (1.50 pts) In which of the myograms is incomplete tetanus occurring?

- A) Myogram A
- B) Myogram B
- C) Myogram C
- D) Myogram D

134. (1.50 pts)
There are 3 phases in a twitch which are the latent period, contraction phase, and relaxation phase. Which of the myograms above have a relaxation phase? Choose all that apply.

(Mark **ALL** correct answers)

- [x] A) Myogram A
- [ ] B) Myogram B
- [x] C) Myogram C
- [x] D) Myogram D

135. (7.00 pts)
How is myogram A different from myogram C? Explain in terms of the molecular level. Include the terms sarcoplasmic reticulum, troponin, and cross bridges in your response. Mak sure to connect your thinking and be sure to contrast the two!

Expected Answer: In myogram A, multiple twitches occur before the muscle fully relaxes (+1). Calcium has not been fully transported back into the sarcoplasmic reticulum (+1), meaning some calcium is still bound to troponin (+1) and cross bridges still form between actin and myosin (+1). Subsequent twitches would add even more calcium into the sarcoplasm, causing greater levels of contraction to occur. In myogram C, calcium fully unbinds from troponin (+1) and re-enters the sarcoplasmic reticulum (+1) after stimulation. This causes cross bridges to stop forming and the muscle to fully relax between contractions (+1).

[10.5] In an experiment, a scientist chooses 2 conditions to apply to a solution with actin and myosin proteins. Up to two types of substances were added to the solution. The myosin used in the experiment had their ATPase function removed.

The viscosity of the solution was then measured after a sufficient amount of time passed and was compared it to the original viscosity before the conditions were applied. Viscosity is the measure of resistance to flow, and fluids with **larger particles have a higher viscosity**. The data is shown below:

Condition	**A**	**B**
C	Viscosity stays the same	Viscosity increases
D	Viscosity stays the same	Viscosity stays the same

In each trial, a set of conditions were applied.
These conditions are labeled A-D and are listed below in no particular order.
1- Limited amounts of ATP added
2- No ATP added
3- Excess calcium added
4- No calcium added

136. (1.50 pts) Which condition corresponds to A?

- A) 1
- B) 2
- C) 3
- D) 4 (selected)

137. (1.50 pts) Which condition corresponds to B?

- A) 1
- B) 2
- C) 3 (selected)
- D) 4

138. (1.50 pts) Which condition corresponds to C?

- A) 1
- B) 2 (selected)
- C) 3
- D) 4

139. (1.50 pts) Which condition corresponds to D?

- A) 1 (selected)
- B) 2
- C) 3
- D) 4

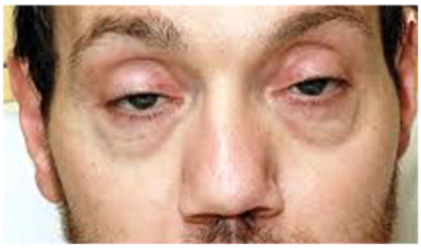
140. (4.50 pts) How would the data in the table above change if myosin still had its ATPase activity? Explain why (Hint: think about the amount of ATP added into the solution).

Expected Answer: When calcium and ATP is added, the data would reflect that the viscosity increases instead of staying the same (+1.5). When the condition is applied to the solution, ATP binds to myosin and releases it from the actin, then myosin would cleave the ATP and bind back onto actin (+1.5). After the limited amounts of ATP is depleted, the myosin would stay bound to actin, increasing particle size and thus viscosity (+1.5).

[14.5] Pathology: Identification

Note: Disease, disorder, and injuries are used synonymously in this section

[9] The following questions pertain to the figures below:



141. (1.00 pts) What disease is related to the pictures above? (Answer as stated in the 2021 rules)

Botulism

142. (1.00 pts) What type of pathogen is this organism?

- A) Virus
- B) Bacteria
- C) Protozoan
- D) Fungus

143. (1.50 pts)
This disease can be spread through improperly canned food, as shown in the right picture. What condition in the environment of canned foods allow for this disease to thrive? Choose all that apply.

(Mark **ALL** correct answers)

- [x] A) Low pH
- [ ] B) High pH
- [x] C) Low oxygen level
- [ ] D) High oxygen level

144. (1.50 pts) What is the medical term for the symptom displayed on the left picture? (One word answer)

ptosis

145. (3.00 pts)
The organism that causes this disease releases a chemical that cuts certain proteins, disrupting a process that prevents ACh from being released. What is this process? What class of proteins are affected?

Expected Answer: Synaptic vesicle fusion (+1.5). SNARE proteins (+1.5).

146. (1.00 pts) Choose any of the following that is a treatment for this disease.

(Mark **ALL** correct answers)

- [x] A) antitoxin
- [ ] B) vaccine
- [ ] C) muscle relaxants
- [x] D) ventilator

[5.5] The following questions pertain to the prompt below:

A rather tall man with scoliosis comes to the physician's office. In a physical examination the doctor notices that the patient's chest is slightly sunk in and that he has stretch marks on his legs.

147. (1.50 pts) What disease does the man have? (answer as stated in the 2021 rules)

Expected Answer: Marfan's syndrome

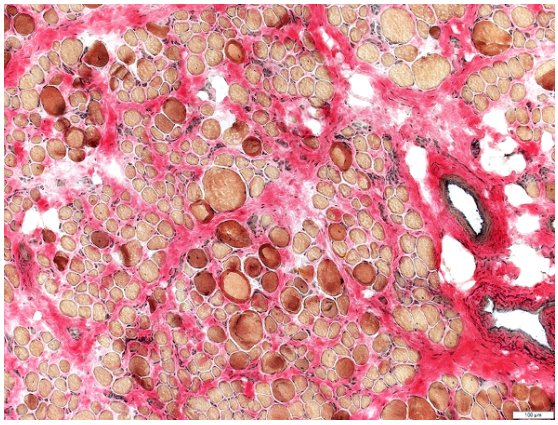
148. (2.00 pts) What is the medical term for the symptom of the sunken chest? (Two word answer)

Pectus excavatum

149. (2.00 pts)
This disease is caused by the mutation of the protein fibrillin-1. Fibrillin-1 is the main component of microfibrils, a strong rope-like protein found in extracellular matrices. Fibrillin-1 also provides a scaffolding for elastin, which gives elasticity. Given this, explain how the mutation in fibrillin causes the loss of tissue integrity and elasticity.

Expected Answer: The mutation in fibrillin causes less viable microfibrils, decreasing the integrity of tissue (+1). This mutation also causes less scaffolding for elastin, decreasing elasticity (+1).

[12.5] Pathology: Case Study



Bobby is a 6-year-old boy. He often has trouble walking and falls over often. Despite having a normal muscle size, he cannot lift heavy objects. He has issues with asthma and needs glasses. Further analysis of a sample of his muscle tissue gives the picture above.

150. (1.50 pts) What is the abnormality in the picture?

Expected Answer: Muscle tissue is being replaced by connective tissue

151. (3.50 pts) What do you diagnose Bobby with? Give TWO specific reasons why based on the prompt.

Expected Answer: Duchenne muscular dystrophy (+1.5). he has trouble walking, he falls often, he is a young boy, normal muscle size but is weak (+1 EACH for ANY 2)

152. (3.50 pts)
When Bobby falls over, he often uses a certain maneuver to help himself get back up. Identify the name of this maneuver, and describe what it is. What is the reason for doing this?

Expected Answer: Gower's sign (+1.5). Climb up by walking hands up legs (+1). Hip and thigh muscles are weak (+1).

153. (3.00 pts) This disease involves a mutation in a certain protein. What is it, and what is its function?

Expected Answer: Dystrophin (+1). It helps attach the endomysium to the muscle fiber, and it helps anchor the cytoskeleton to the inside of the cell (+2 for function- various answers accepted).

154. (1.00 pts) Is there a cure to this disease?

- A) Yes
- B) No

- **Congratulations on finishing this test!** Give yourself a pat on your back! :D
- Feedback is greatly appreciated, it would be very helpful to me if you take just a minute or two to fill out the **feedback form** (https://forms.gle/CqV1Uj536UPKUsPJA)
- PM *Mr.Epithelium* on Scioly if you have any questions about the test!